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A COMPENSATING TREATMENT OF GRAVI[illegible]

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As was stressed by Yang - Mills each conservation law or invariance group induces a corresponding vector field like introducing a vector potential of electromagnetic field by means of gauge transformation

$$U = \exp ie \Lambda (x)$$

with phase depending from coordinates. The connection with charge conservation is well known. It may be of great interest to generalize these considerations applied already to iso-spin and baryonic charge conservation, to other bosonic fields, especially to gravidynamics.

With this aim we consider localized Lorentz transformations with parameters being non constant but depending from coordinates. Now keeping invariance one must compensate the derivatives of these parameters by a coupling : a new field must be introduced and this compensating field proves to be essentially identical with gravitation field of Riemann-Einstein general relativity.

In our work inspired by Sakurai's article [1] with A.M. Brodski and H.A.Sokolik [2] we preferred to treat transformation properties of the fields at finite transformation of a local group, which seems to be more correct as Lie's theorem is not immediately applicable to local group. Our results were obtained independently from interesting work of Utiyama [3] who used infinitesimal transformations. Analogous considerations were established also in an unpublished work of J.Schwinger.

This new approach to general relativity is of interest not only by its simplicity but also by the very fact of introduction of a group generalizing Lorentz group, which means the existence of some symmetry of Riemann-Einstein Space which generally speaking is devoided of any symmetry, as was emphasized by E.Cartan. So let us require covariance of equation for particles of arbitrary spin value

$$(h_{\mu}(o)\,\gamma\,\partial_{\mu} + im)\psi = 0$$

where ψ is transformed by means of arbitrary [illegible] S, and tetrapods $h_\sigma(p)$ are assumed to be functi[illegible]ates. Then to compensate the term $S \partial_\sigma S^{-1} = I_{nl} (\partial_\sigma C_{sp}) N_{ps}$ it is necessary to generalize ∂_σ to, compensating (covariant) derivative

$$\nabla_\sigma = \partial_\sigma - \Gamma_\sigma \qquad \text{with } \Gamma_\sigma = \frac{1}{2} I_{nm} \Delta_\sigma (m,n) ,$$

I being generators of the group, ε - its parameters, $N = \int_0^1 \exp (t \, \varepsilon \, C) \, dt$ (indices being omitted!), C - structural constants of the Loremtz gpoup, Δ - Ricci's coefficients. For instance, for spinor Dirac field ($\mathcal{L}_p = \gamma_p$) one gets immediately well known coefficients (Fock-Ivanenko [4])

$$\Gamma_\sigma = \frac{1}{4} [\gamma_e \gamma_m] \Delta_\sigma (m, \ell)$$

Of course, a tensor form, describing e.g. torsion can be added to compensating derivative. It is interesting to note that parallel displacement of spinors which requires in a natural way application of tetrads, introduces, in the case of a space endowed with torsion a non-linear supplement in Dirac equation as was shown by V.Rodičev [5], moreover of the pseudo-vectorial type chosen on various grounds preferrably by Heisenberg from all possible non-linear supplements investigated previously in our work with A.Brodski. All this seems to represent a step towards geometrical interpretation of an unified non-linear theory which appears to be based on such most elementary entities as spinors and tetrads, characterizing both curvature and torsion.

References:

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